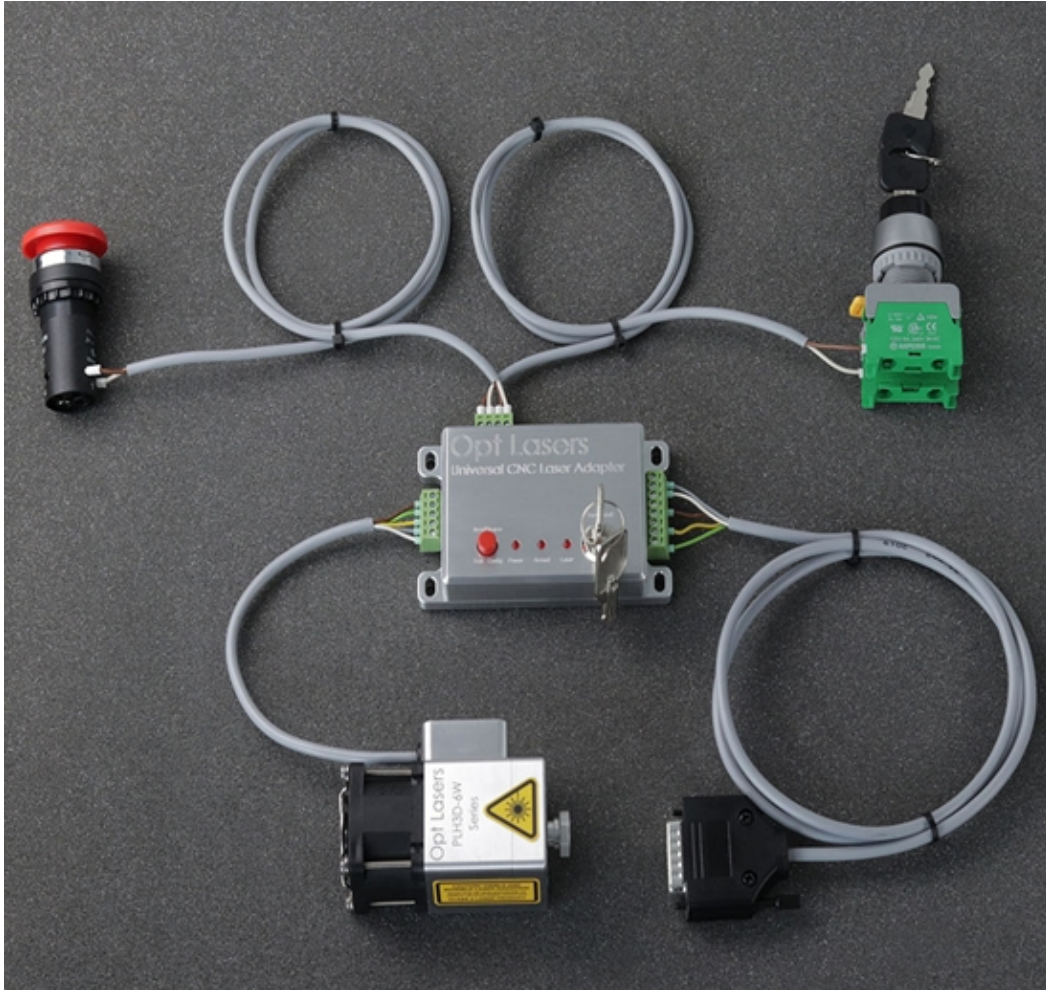


Opt Lasers GRAV



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PLH3D-CNC Adapter (center), PLH3D-6W-XF (bottom left), optional cables with CNC machine connector (bottom right), external keylock (top right) and stop button (top left).

The PLH3D-CNC Adapter serves as a versatile interface and safety unit connected between a CNC machine and a high-performance PLH3D laser head.

Many types of CNC machines and 3D printers available on market, with different control voltage standards and levels available, may be used to control the PLH3D head. The PLH3D-CNC Adapter converts all these signals to the standard compatible with the PLH3D head.

Key features of the PLH3D-CNC Adapter:

- Key-lock for preventing use by unauthorized personnel;
- Safe start;
- Mode button - can be used for arming/disarming, generating laser pulse for a test, and configuration enable settings;
- Status LEDs - power on, armed, laser working, and setting of Enable Modes;
- Connectors: PLH3D laser head, control, extensions, and external switches;
- Power connector;
- External desktop low-noise power supply;
- Machined aluminum quality enclosure;
- Optional PLH3D laser cables and signal cables dedicated to a CNC machine or controller type;
- Optional external key-lock, stop button, and sensors;
- Compatible with PLH3D laser heads;
- Can be configured for matching with the majority of CNC machines and 3D printers.

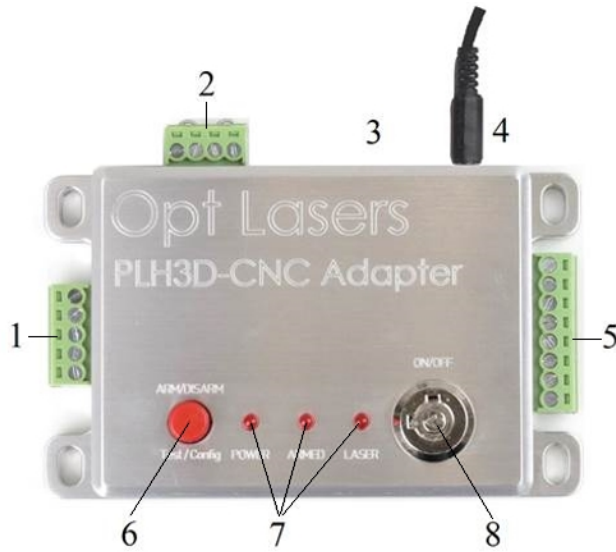
The laser head can be made operational by selecting to “arm” and “disarm” the laser head. Arming means turning the head power supply on; the armed head is then able to generate a laser beam. Disarming (turning the head power supply off) brings the laser head to a safe state where generating a laser beam is altogether impossible.

Built-in safety mechanisms prevent misuse and unexpected behavior in case of an emergency. The key switch protects the laser head from being armed by children and other unauthorized people. Arming the laser head is always done manually by the user, by pressing a button. Special circuitry prevents arming during an internal electrical malfunction. The laser head is automatically disarmed in case of an emergency such as a loss of the mains supply (grid power), PSU failure, breakage, or disconnection of the laser head cable. After disarming, the system remains in a safe state, and rearming always requires the user to press the button.

Additional safety mechanisms can be incorporated into the system by adding up to two external switches (e.g., a limit switch, a key switch, or an e-stop). There is also an additional extension connector for future purposes

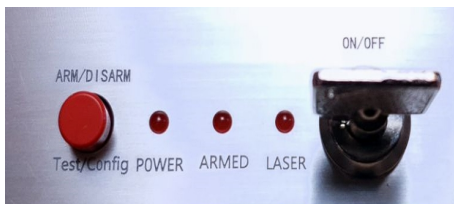
Additional features are industry-standard screw connectors. A dedicated, low-noise desktop power supply unit assures compatibility and reliability as well as eliminates problems caused by using third-party power supplies. The general status (power on, arming, laser working) may be inspected at a glance by looking at the three LEDs.

Controls and Indicators of PLH3D-CNC Adapter



1. Laser head connector (with pluggable terminal block)
2. External switch connector (with pluggable terminal block)
3. Extensions connector
4. Power supply connector
5. Control connector
6. Mode button
7. LED status indicators
8. Key switch

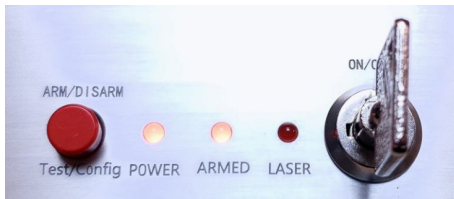
Main States of the PLH3D-CNC Adapter:



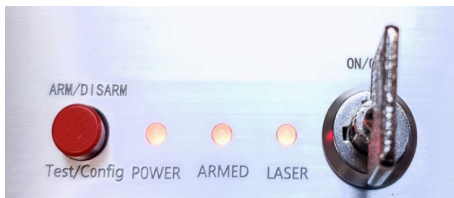
Power Supply - **Off**; Laser Head - **Off**;



Power Supply - **On**; Laser Head - **Off**;



Laser Head - **Armed**; Controlling Signal - **Absent**; Lasing - **No**;

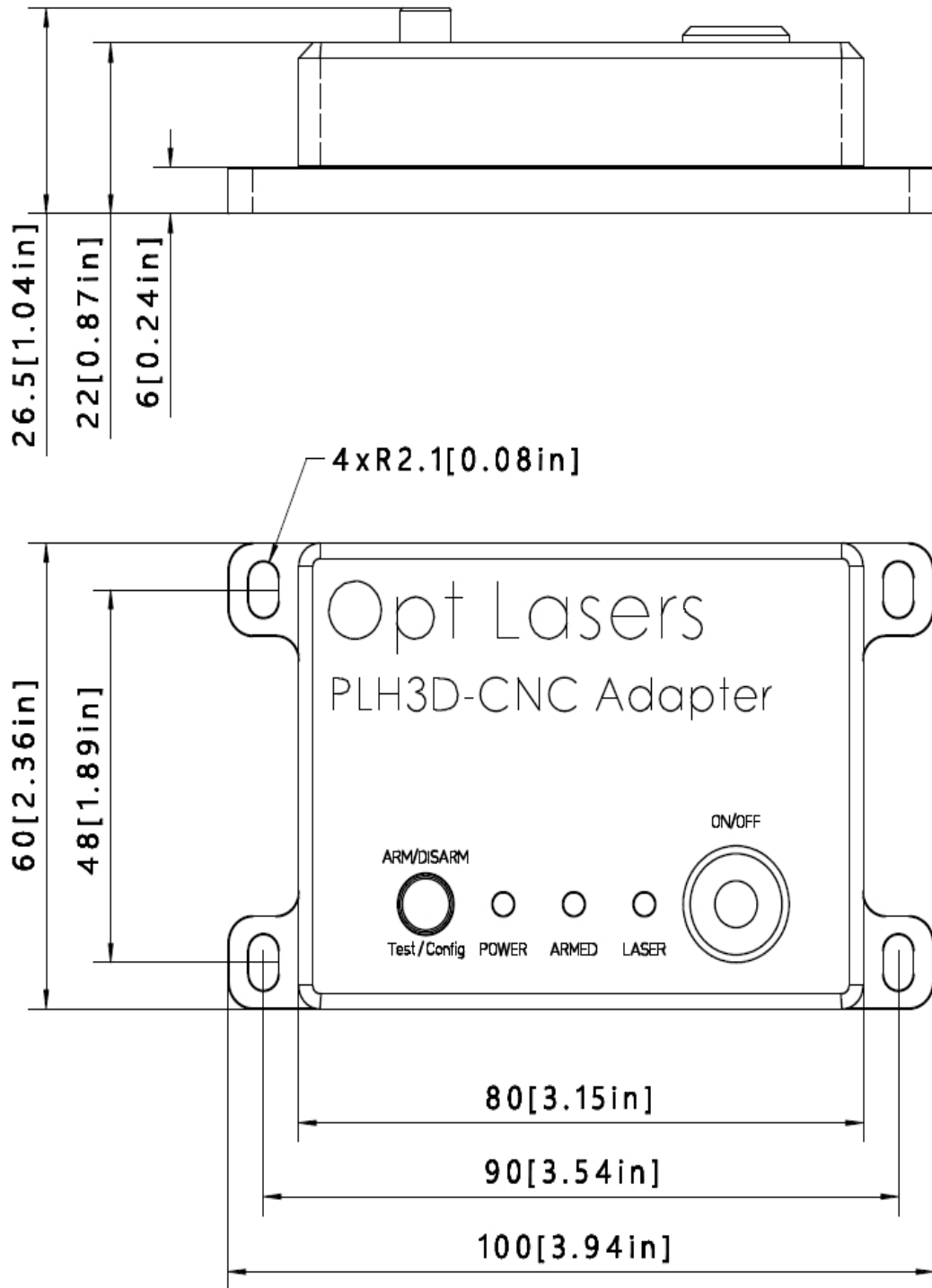


Laser Head - **Armed**; Controlling Signal - **Present**; Lasing - **Yes**;

The detailed description of the distinct sections of the Adapter:

1. LASER HEAD CONNECTOR
 - 1.1. Attach the laser head cable here.
2. EXTERNAL SWITCH CONNECTOR
 - 2.1. Up to two external switches (e.g., a limit switch, a key switch, or an e-stop) that arm/disarm the laser head can be connected to the PLH3D-CNC Adapter. When not using a switch, replace it with a jumper wire.
 - 2.2. Opening any external switch disarms the laser head immediately.
 - 2.3. Then, even if the switch has been closed again, the system will stay disarmed. The mode button must be pressed to rearm the laser head.
3. EXTENSIONS CONNECTOR
 - 3.1. Intended for future applications.
4. POWER SUPPLY CONNECTOR
 - 4.1. Plug in an external 15-24V DC power supply here. We strongly recommend using a dedicated power supply unit exclusively for the PLH3D-CNC Adapter.
5. CONTROL CONNECTOR
 - 5.1. Controlling inputs and outputs are attached here.
6. MODE BUTTON
 - 6.1. Pressing the mode button once will arm the laser head. Doing so will cause the ARMED LED indicator to light up, implying the laser head is in the armed state; the fan in the laser head starts to work as well. To disarm the laser head, press and release the button again.
 - 6.2. A test laser pulse can be generated in the armed state by pressing and holding the mode button for at least 1.5 seconds. An approximately one-second-long pulse at 100% power is then issued on the laser head control line. The LASER LED lights up, confirming the appearance of the pulse. A single pulse will be generated even if the button is held for longer. Please refer to "Getting Started" section.
 - 6.3. Holding the mode button while turning the power on activates the configuration mode. For further details, please visit the *For Advanced Users* section.
7. LED STATUS INDICATORS
 - 7.1. The POWER LED shows the presence of power and also signals supply errors.
 - 7.2. The ARMED LED shows the arming state. Furthermore, it also signals both disarming by an external switch and disconnecting the laser head.
 - 7.3. The LASER LED shows the presence of the laser head controlling signal (a steady one or a pulse-like). Note that controlling the laser head is disabled in the disarmed state.
 - 7.4. In configuration mode, the LEDs show the current option(s). Refer to the *For Advanced Users* section. For adapters sold after 20-July-2020, the currently set Enable Option will be displayed for 1 second after turning the switch key on.
 - 7.5. For adapters sold after 20-July-2020, the currently set Enable Option will be displayed for 1 second after turning the switch key on.
8. KEY SWITCH
 - 8.1. Turn the key switch clockwise to the upper position to switch the PLH3D-CNC Adapter on. Turn the key switch counterclockwise to the left position to switch the PLH3D-CNC Adapter off.

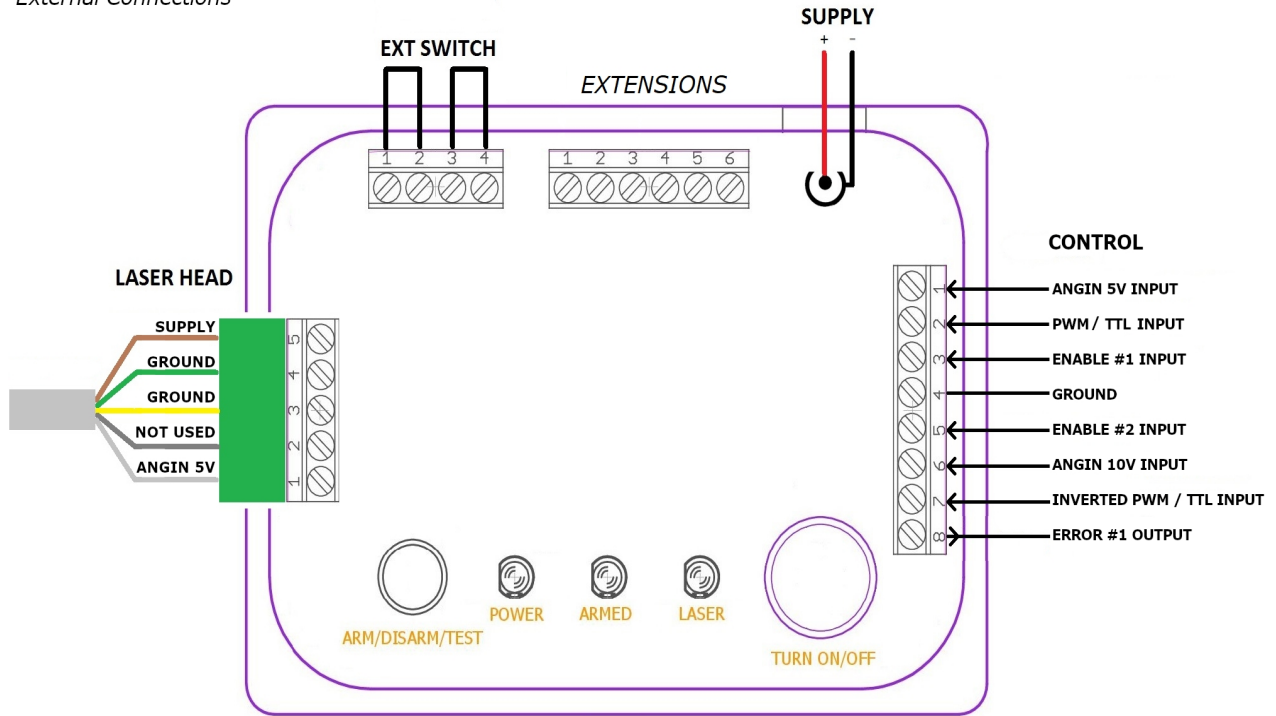
Dimensions:



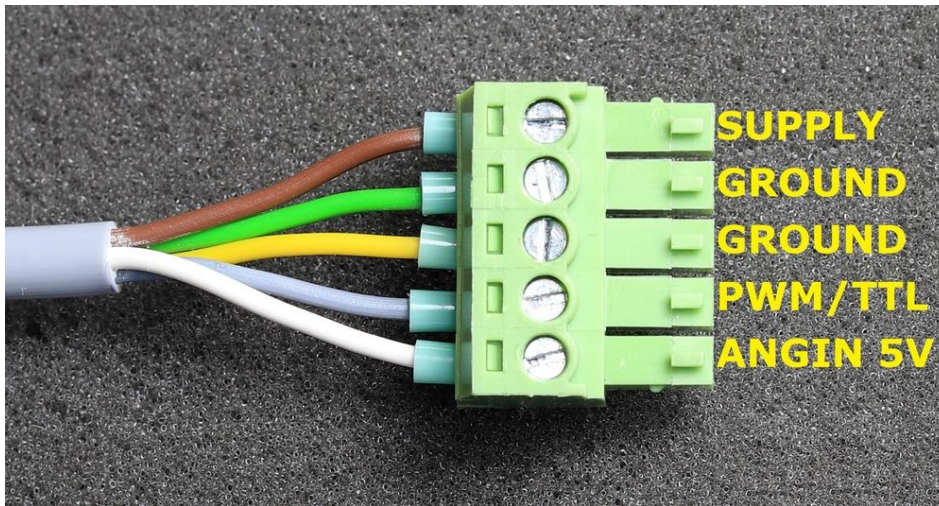
Pinout:

PLH3D-CNC Adapter

External Connections



Pinout of the cable located between the laser head and the PLH3D-CNC Adapter:



Note: If you are using a laser docking station, this cable should be plugged into the laser docking station instead into the laser head.

Getting Started

1. Connect the laser head to the PLH3D-CNC Adapter.
 - a) At this instance, the laser head ought to be mounted on your CNC machine or 3D Printer in a firm manner.
 - b) If you are using the Magnetic Laser Docking Station, connect the laser head to the docking station. Please follow it up by connecting the docking station to the PLH3D-CNC Adapter. This can be done via the 5-wire cable, which is provided in the bundle.



- c) To find out more about how to connect the cables, feel free to have a look at our video guide available at https://youtu.be/MQ5v1CD_rlc
- d) Remember to subscribe to our YouTube channel. You will immensely benefit from Opt Lasers' hands-on tutorials and inspirations.

2. Connect the signal wire to the PLH3D-CNC Adapter, and to the CNC machine controller (a visual representation is depicted in the "Connection to CNC Machines" section).



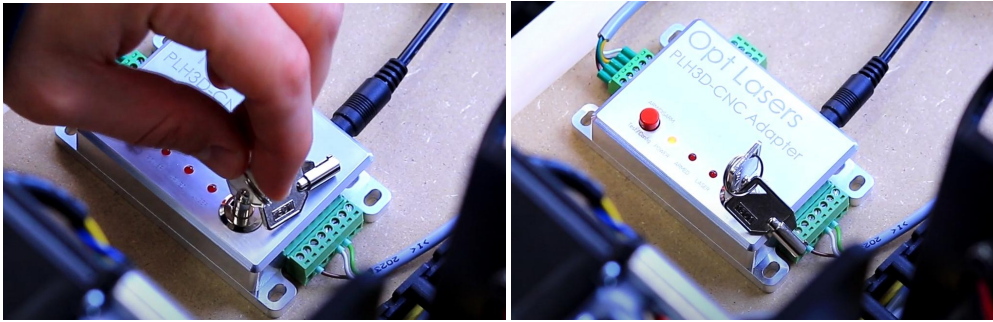
3. Important: Please don't forget to wear a pair of laser safety glasses that can shield you from 400 to 500 nm light radiation.



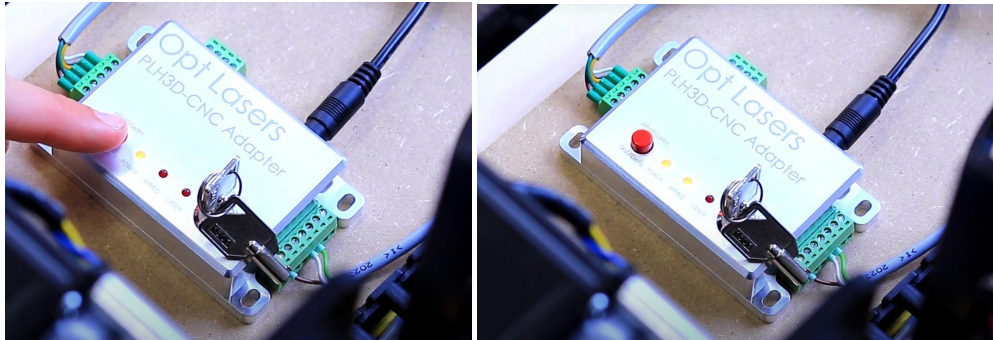
4. Place a piece of non-reflective material under the laser head, such as balsa or plywood. During the next steps, the laser will be turned on.
5. Connect the power supply to the PLH3D-CNC Adapter.
6. Turn the switch key in the PLH3D-CNC Adapter.

Note: After turning the key switch On, the current Enable Option setting will be displayed with indication LEDs for a second. (Applicable for PLH3D-CNC adapter sold after 20-July-2020)

After that Power LED should be lit. If it's not, go to the "Troubleshooting" section.



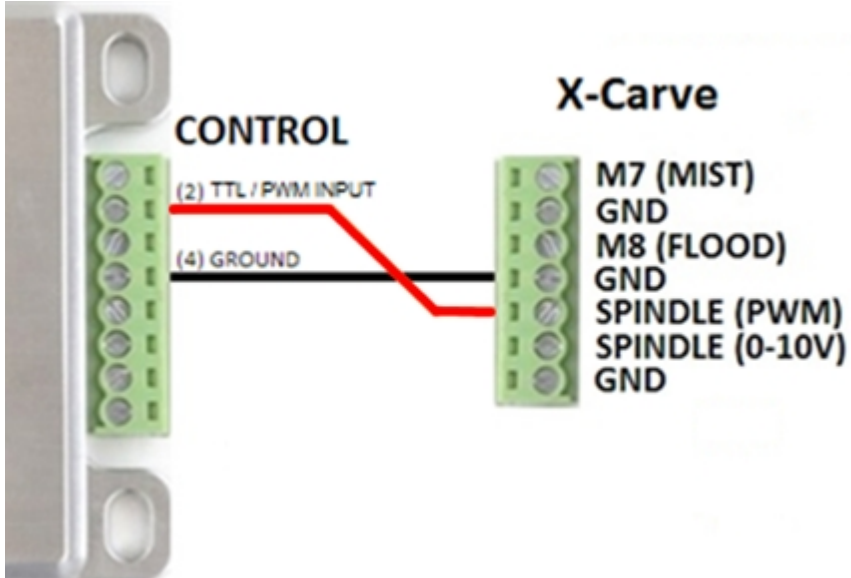
7. Press the Mode button once. The Armed and Power LEDs ought to be radiant at this point. If this is not the case, go to the "Troubleshooting" section of the user's manual.



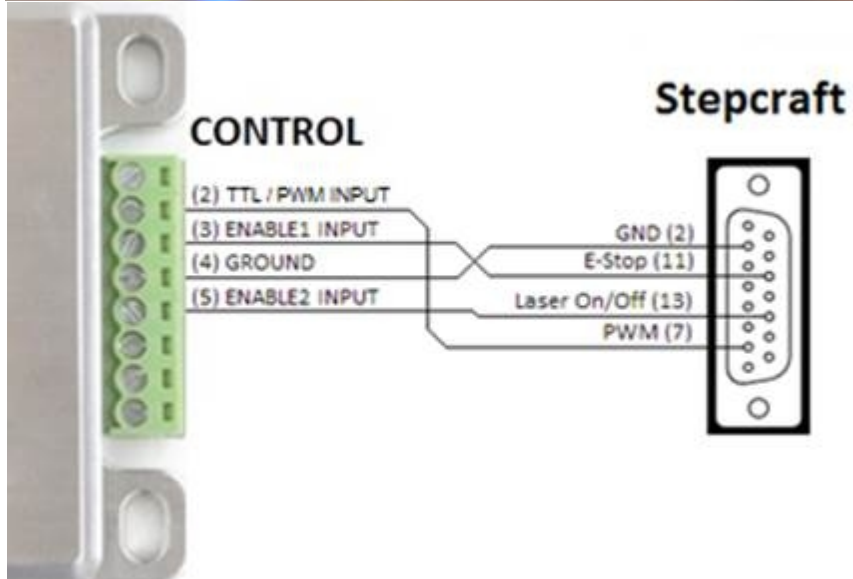
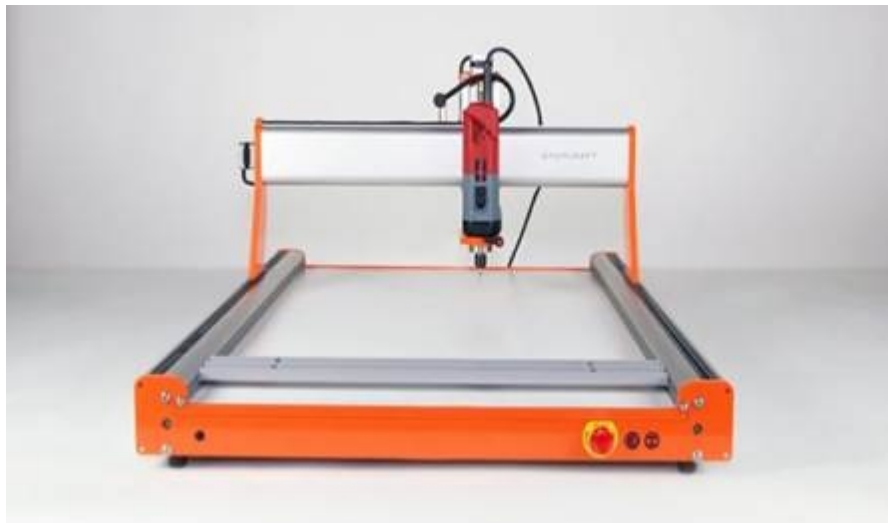
8. Now the laser head will be tested. Press the MOD button continuously for approximately 2 seconds. A short laser pulse (at full power), lasting for just about 1 seconds, will be generated. This procedure will verify whether the laser head is connected in a correct fashion. If it doesn't work, go to the "Troubleshooting" section.
9. Once the laser has been connected properly, and the procedure described above has been concluded without any issues, you can start engraving and cutting using your CNC machine with the laser head attached.

Connection to CNC machines

1. X-Carve



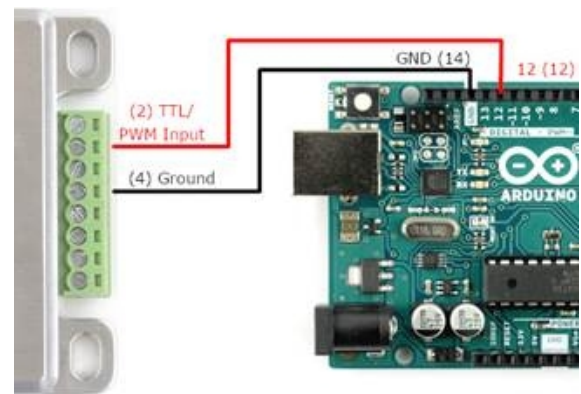
2. Stepcraft



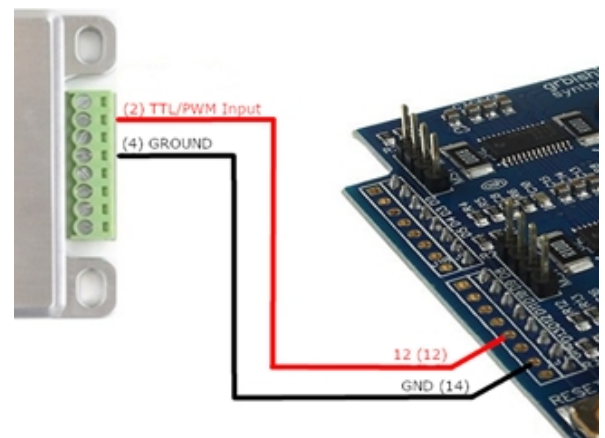
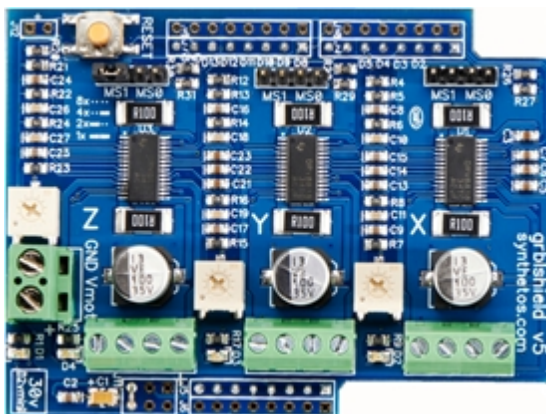
3. Shapeoko



Arduino Uno:



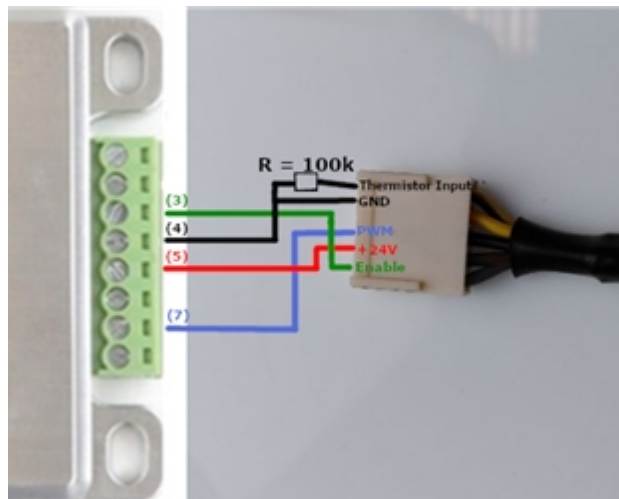
gShield (grblShield v5):



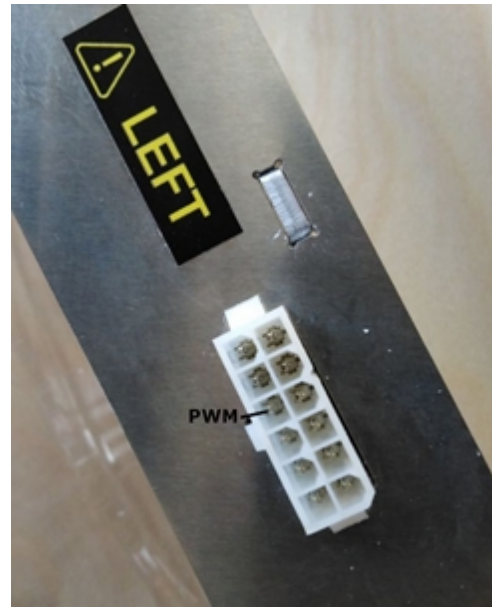
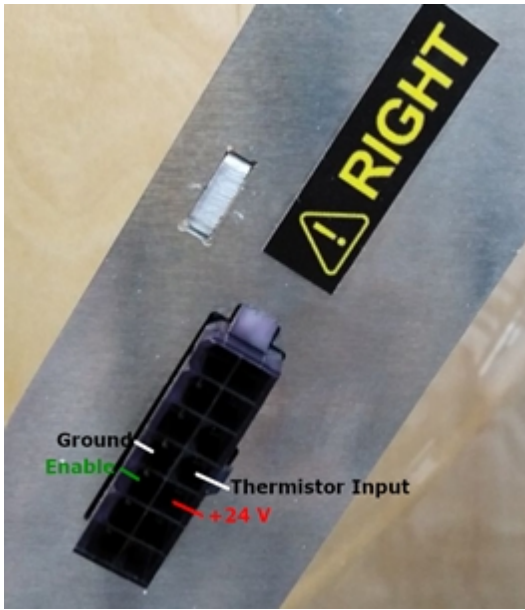
4. ZMorph



Opt Lasers Signal Cable for the PLH3D-6W-ZMorph Laser Head:



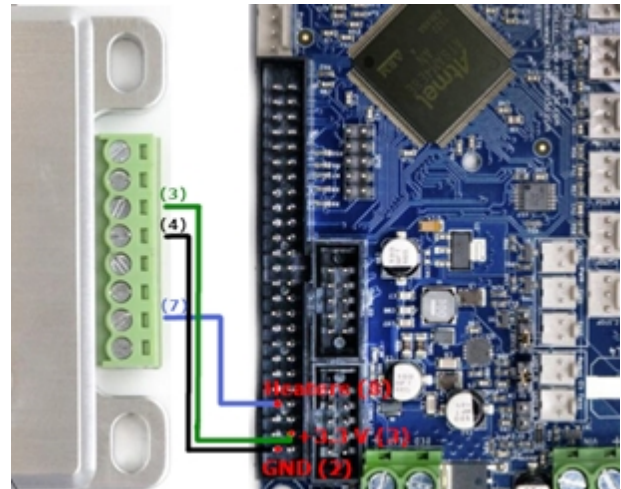
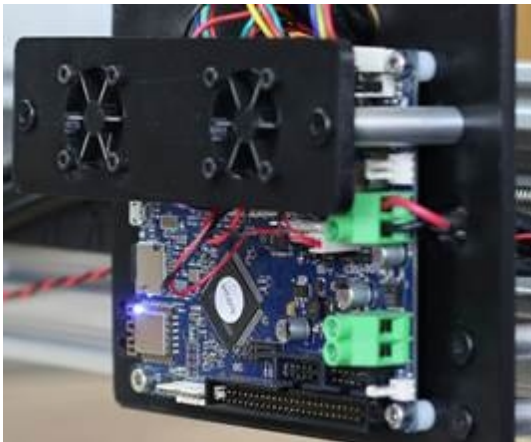
ZMorph itself (pins at adapter same as above):



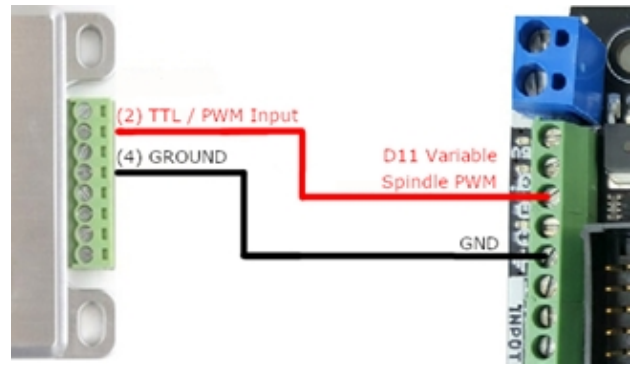
5. WorkBee



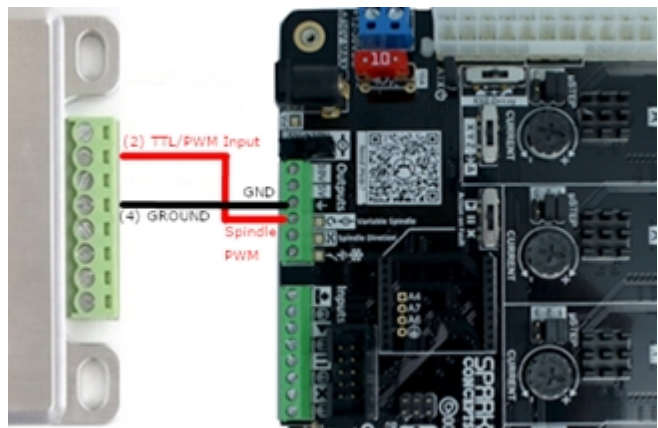
Duet Controller



CNC xPro v3 Controller



CNC xPro v4 Controller



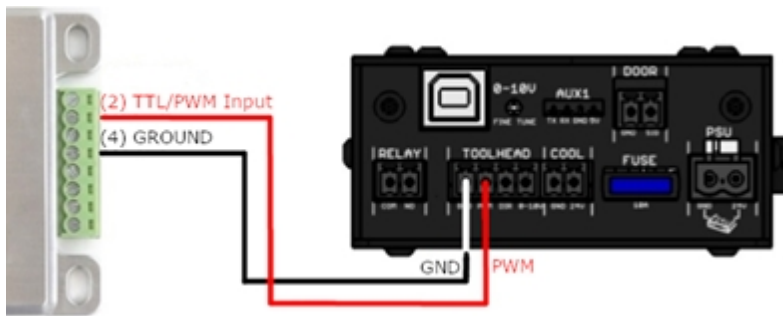
6. CNC Routers Parts / Avid CNC



Smooth Stepper



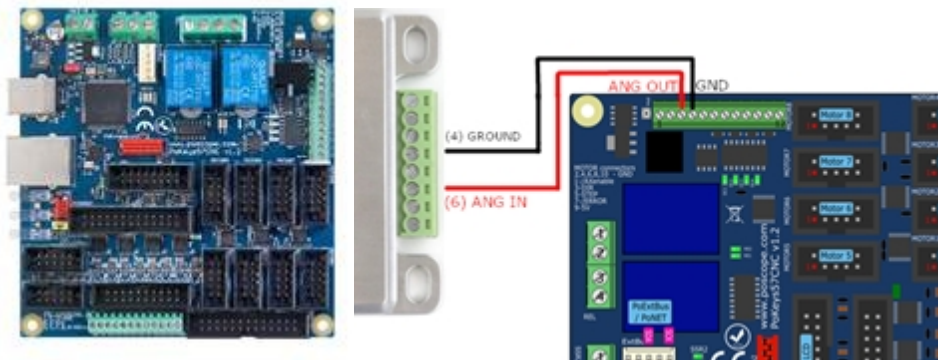
7. BlackBox Motion Control System



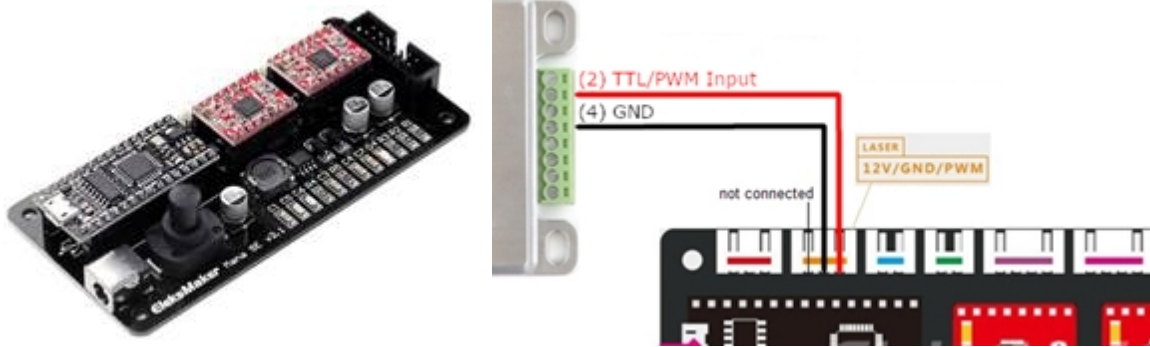
8. CSMIO Controller



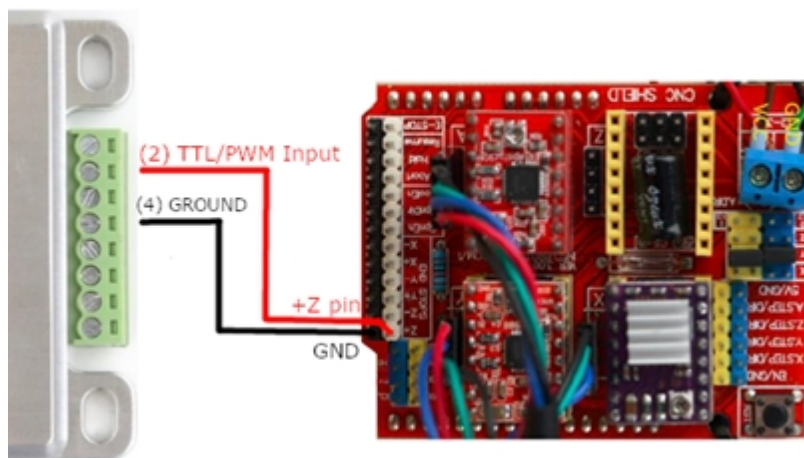
9. Pokey57 CNC Controller



10. EleksMaker



11. Openbuilds



PLH3D-CNC Adapter Enable Options

Specific CNC machines issue special “disable/enable” signals for turning the laser beam off and on. The PLH3D-CNC Adapter can be set in such a way that the laser beam is enabled only for certain states on two Enable inputs and disabled in other cases. A total of 12 distinct combinations of states (called “Enable Options”) may be selected. This allows the PLH3D-CNC Adapter to connect with virtually any machine.

The table below shows the appropriate settings of the “Enable Options” for a choice of widely used machines.

The PLH3D-CNC Adapter is shipped with the Enable Options already matching the user’s machine.

In any case, it is worth double-checking to confirm that the befitting software is loaded before operating the laser head.

<i>Machine</i>	<i>Enable options</i>		
X-Carve	0		ENABLE1=any ENABLE2=any
Stepcraft	11		ENABLE1=TOGGLING ENABLE2=HIGH
Shapeoko	0		ENABLE1=any ENABLE2=any
Z-Morph	7		ENABLE1=LOW ENABLE2=HIGH
WorkBee/i2R CNC with Duet Controller	2		ENABLE1=HIGH ENABLE2=any
WorkBee with CNC xPro Controller	0		ENABLE1=any ENABLE2=any
Avid CNC (Smooth Stepper)	0		ENABLE1=any ENABLE2=any
BlackBox Motion Control System	0		ENABLE1=any ENABLE2=any
<i>Most cases not covered above</i>	0		ENABLE1=any ENABLE2=any

NOTES: 1. LED is off
 LED is lit
 LED is flashing

2. ANY means:

- lack of connection or any voltage in the 0 - 24 V range.

3. LOW means:

- either a DC voltage from 0 to +0.8 V,
 - or a connection to GROUND through a 0 ... 1 kΩ resistance.

4. HIGH means:

- a connection to a DC voltage from +3 V to +24 V through a 0 ... 1 kΩ resistance.

5. TOGGLING means:

- LOW-to-HIGH or HIGH-to-LOW transitions, 200 ms or less apart.

How to Check Enable Option in PLH3D-CNC Adapter

Note: After turning the key switch On, the current Enable Option setting will be displayed with indication LEDs for a second. Applicable for PLH3D-CNC adapter sold after 20-July-2020. For older version of PLH3D-CNC Adapter please follow the instruction below.

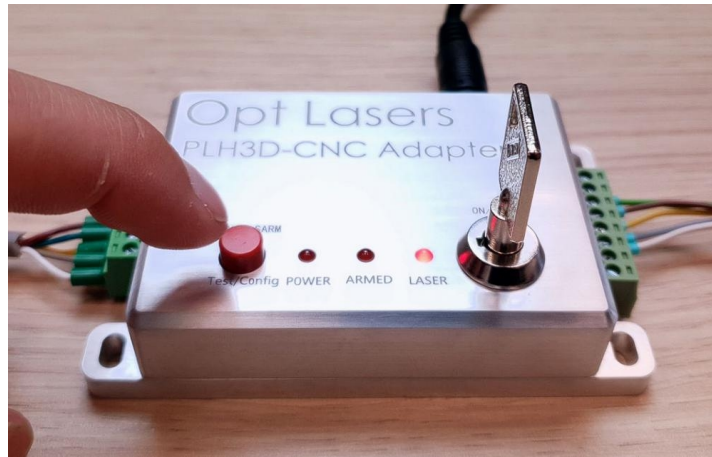
1. Turn the key switch OFF.
2. Press and hold the mode button.



3. Turn the key switch ON while holding the aforementioned button.



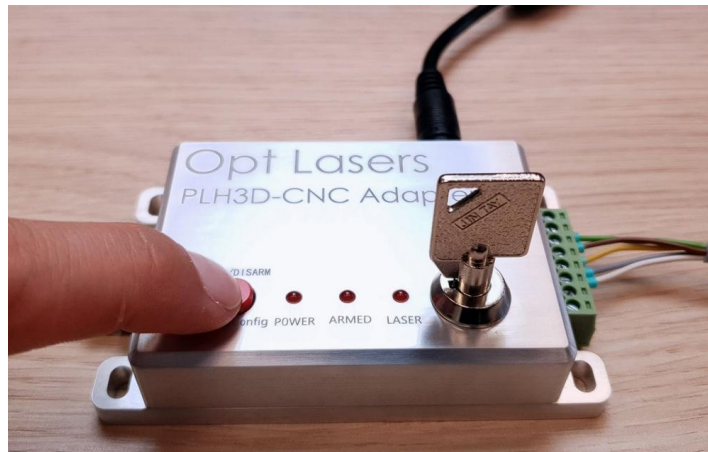
4. Wait approximately one second until any LED is lit and release the button.



5. LEDs will show a combination corresponding to the current setting. Do not press Mode button again.
6. To quit without saving, wait for five seconds until Power LED is lit or turn the switch key off.

How to Set Enable Option in PLH3D-CNC Adapter

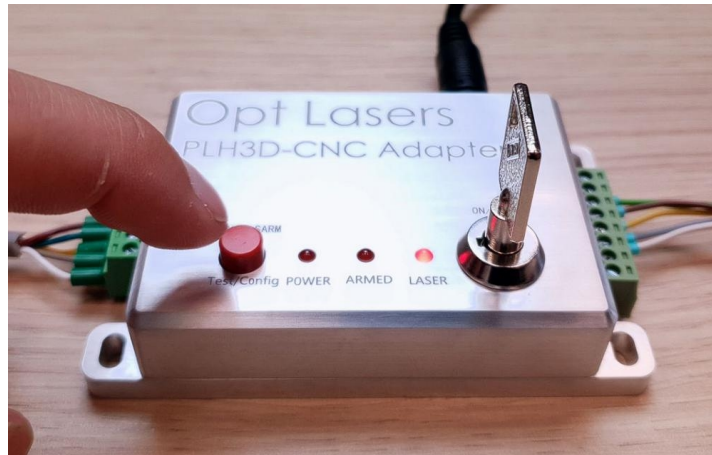
1. Turn the key switch OFF.
2. Press and hold the mode button.



3. Turn the key switch ON while holding the aforementioned button.



4. Wait approximately one second until any LED is lit and release the button.



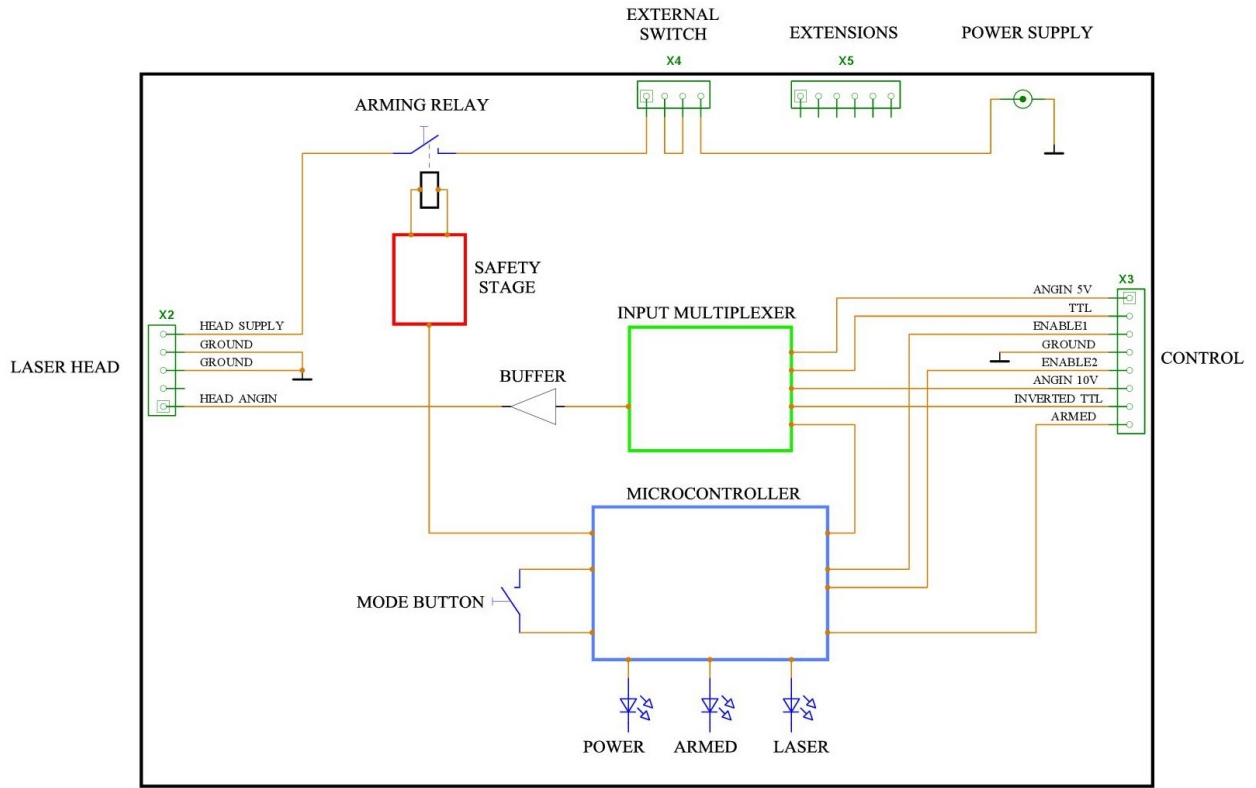
5. LEDs will show a combination corresponding to the current setting.
6. To step to the next setting, press the mode button once. Keep pressing the mode button till you find the settings that you wish to be set.



7. To save the current setting, wait five seconds with the button released. To quit without saving, turn the key switch off before five seconds elapse.

The chosen setting is kept in non-volatile memory and remains unchanged during power-off.

For Advanced Users



Block Diagram

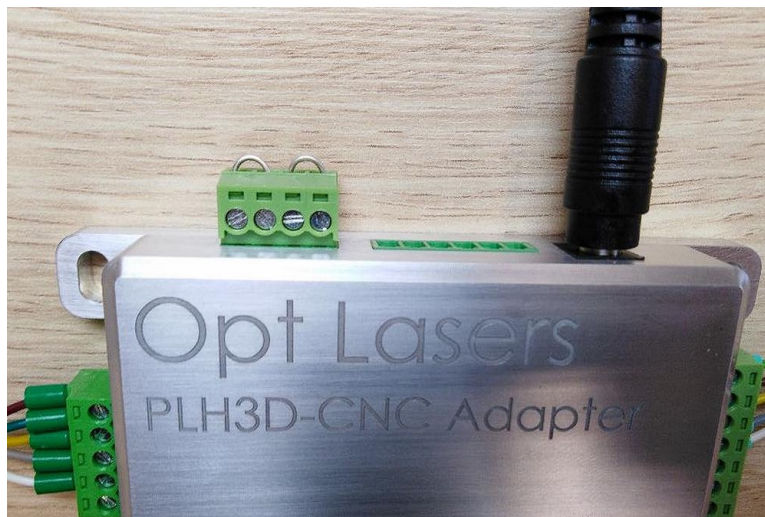
EXTERNAL SWITCH Connector Pinout with Description

Pin no.	Name	External switch
1	A.1	Switch A
2	A.2	
3	B.1	Switch B
4	B.2	

The switches are connected in series with the power supply feeding the power to the laser head through the arming relay. Opening any of the switches disconnects the supply of the laser head and thus disarms it.



Connect the first switch to A.1 and A.2, and the second switch to B.1 and B.2. A lacking switch must be replaced by a jumper wire.



The switches and jumpers can withstand the laser head supply current up to 4 A, and a 30 V DC voltage.

CONTROL Connector Pinout with Description

Pin no.	Name	Description
1	ANGIN 5V INPUT	A proportional (analogue) modulation input, operating in a 0-5 V range (corresponds to 0% - 100% levels respectively). The input withstands voltages up to 24 V DC. The input impedance is 3.9 k Ω .
2	TTL/PWM INPUT	A digital modulation input that accepts PWM and TTL signals. The voltage range of 0-0.8 V corresponds to "off" while the voltage range of 2-24 V corresponds to "on". Compatible logic control signals are: 0/3.3V, 0/5V, 0/10V and 0/24V. The input impedance is 10 k Ω .
3	ENABLE1 INPUT	A digital input that enables/disables laser controlling. The input accepts digital signals where 0-0.8 V corresponds to LOW while 3-24 V corresponds to HIGH. The input impedance is approx. 35 k Ω .
4	GROUND	Ground signal.
5	ENABLE2 INPUT	A digital input that enables/disables laser controlling. The input accepts digital signals where 0-0.8 V corresponds to LOW and 3-24 V corresponds to HIGH. The input impedance is approx. 35 k Ω .
6	ANGIN 10V INPUT	A proportional (analogue) modulation input, operating in a 0-10 V range (corresponds to 0% - 100% levels respectively). The input withstands voltages up to 24 V DC. The input impedance is 7.8 k Ω .
7	INVERTED TTL/PWM INPUT	It is an inverted digital modulation input that accepts PWM and TTL signals. The voltage range of 0-0.8 V corresponds to "on" and the voltage range of 2-24 V corresponds to "off". Compatible logic control signals are: 0/3.3V, 0/5V, 0/10V and 0/24V. The input impedance is 10 k Ω .
8	ARMED OUTPUT	An open-drain output. It is connected to GROUND when the laser is disarmed, and open (high-impedance) when the laser is armed. May be used as an active-low error signal to the controller. The maximum current is 100 mA and the maximum voltage is 40 V DC.

Enable Options

Specific CNC machines issue special “disable/enable” signals for turning the laser beam off and on. The PLH3D-CNC Adapter can be set in such a way that the laser beam is enabled only for certain states on two Enable inputs and disabled in other cases. A total of 12 distinct combinations of states (called “Enable Options”) may be selected. This allows the PLH3D-CNC Adapter to connect with virtually any machine.

Disabling affects the controlling signal only and does not cause the disarming of the laser head.

All 12 available options are listed below:

option	LED combination	laser head controlling condition	
		ENABLE1 input	ENABLE2 input
0	○ ○ ● POWER ARMED LASER	any state	any state
1	○ ● ○ POWER ARMED LASER	LOW	any state
2	○ ● ● POWER ARMED LASER	HIGH	any state
3	● ○ ○ POWER ARMED LASER	any state	LOW
4	● ○ ● POWER ARMED LASER	LOW	LOW
5	● ● ○ POWER ARMED LASER	HIGH	LOW
6	● ● ● POWER ARMED LASER	any state	HIGH
7	○ ○ ✘ POWER ARMED LASER	LOW	HIGH
8	○ ✘ ○ POWER ARMED LASER	HIGH	HIGH
9	○ ✘ ✘ POWER ARMED LASER	TOGGLING	any state
10	✘ ○ ○ POWER ARMED LASER	TOGGLING	LOW
11	✘ ○ ✘ POWER ARMED LASER	TOGGLING	HIGH

NOTES: 1. ○ LED is off
● LED is lit
✘ LED is flashing

2. ANY means:

- lack of connection or any voltage in the 0 - 24 V range.

3. LOW means:

- either a DC voltage from 0 to +0.8 V,
- or a connection to GROUND through a 0 ... 1 kΩ resistance.

4. HIGH means:

- a connection to a DC voltage from +3 V to +24 V through a 0 ... 1 kΩ resistance.

5. TOGGLING means:

- LOW-to-HIGH or HIGH-to-LOW transitions, 200 ms or less apart.

Additional Features

Applicable to PLH3D-CNC adapters sold after 20-July-2020:

1. Enable Option Check at Power-on.

After turning the key switch ON, the current Enable Option setting will be displayed with indication LEDs for a second. Please refer to the table with Enable Option LED combinations, which can be found in the preceding subsection, namely Enable Options. After a second, the display of the currently selected Enable Option LED combination will disappear. The LEDs will then show the status of the device and the adapter will be ready for use.




For more details about the "Enable Options", please visit the foregoing subsection.

2. Laser Head Type Selection.

In order to best recognize a variety of laser head critical states (disconnecting by the external switch, disconnecting the cable, short circuit), a general type of the laser head can be set up. The following settings are possible:

PLH3D-CNC ADAPTER

selection of HEAD TYPE options

option	LED combination	Check	Applicable to
0	 POWER ARMED LASER	Short circuit (only)	Any Opt Lasers' laser head
1	 POWER ARMED LASER	Short circuit and discontinuity*	Only for laser heads with no fan (i.e. PLH3D-6W-LC)
2	 POWER ARMED LASER	Short circuit and discontinuity	PLH3D-2W, PLH3D-6W-Hobby, PLH3D-6W, PLH3D-6W-XF, PLH3D-6W-uSpot, PLH3D-6W-Zmorph, PLH-12000

NOTES: ○ LED is off
● LED is lit

* - In this case, discontinuity of the laser head can only be recognized at sufficient laser power, hence it depends on how the PLH3D-CNC Adapter's controlling inputs are driven.

To check or set up the laser head type option:

1. Turn the key switch off.
2. Press and hold the mode button.
3. Turn the key switch on while holding the button.
4. Wait at least **4 seconds**.
5. Release the button.
6. LEDs will show a combination corresponding to the current setting (please refer to the table above).
7. To step to the next setting press the button.
8. To save the current setting wait 5 seconds with the button released. To quit without saving, turn the key switch off before 5 seconds elapse.

The chosen setting is kept in non-volatile memory and remains unchanged during power-off.

Troubleshooting

Before proceeding with the troubleshooting, please make sure you followed all the steps described in the "Getting Started" section.

If you find any problems using the PLH3D-CNC Adapter, the following table should be able to address it. In case it doesn't, please feel free to contact our support team at contact@optlasers.com.

Problem	Possible reason	Solution
POWER LED is off	The key switch is not turned on.	Turn the key into the upper position.
	The power supply unit is not attached either to the mains (wall) or to the PLH3D-CNC Adapter.	Plug the power supply in.
	There is no mains supply (grid power).	Check the mains supply (grid power).
	The power supply unit is defective.	Replace the power supply unit.
	The PLH3D-CNC Adapter is defective.	Send the PLH3D-CNC Adapter in for a repair.
POWER LED is flashing	The supply voltage is outside the acceptable range.	Use a dedicated power supply unit.
	The power supply unit is defective.	Replace the power supply unit.
	There is an internal PLH3D-CNC Adapter error.	Send the PLH3D-CNC Adapter in for a repair.
Pressing the mode button does not arm the laser head	The external switches are open or not working.	Close the switches or replace them with jumper wires.
	The laser head is not connected.	Connect the laser head.
	There is an internal PLH3D-CNC Adapter error.	Send the PLH3D-CNC Adapter in for a repair.
ARMED LED is flashing	An external switch has been opened.	Close the switch and rearm the laser head by pressing the mode button.
	The connection with the laser head has been broken.	Reconnect the laser head and rearm it by pressing the mode button.
LASER LED is off	There is no laser controlling signal.	Verify whether your controller is connected in a correct fashion and whether it is sending pulses.
	The laser beam has been disabled by the controller.	Verify whether your controller is connected in a correct fashion and whether it is sending pulses.
	The laser head is not armed.	Arm the laser head by pressing the mode button.
	The enable inputs have the wrong state selection.	Provide the right combination of states at the enable inputs.
		Set up the right enable option.
	The laser control signal is fed to a wrong input.	Attach the controlling signal to the right input.
There is no control signal connected.	Check the connections.	